Ecological site FX052X99X084
Slough (Sl)

Last updated: 7/01/2019
Accessed: 05/08/2024

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 052X–Brown Glaciated Plains

The Brown Glaciated Plains, MLRA 52, is an expansive and agriculturally and ecologically significant area. It consists of approximately 14.5 million acres and stretches across 350 miles from east to west, encompassing portions of 15 counties in north-central Montana. This region represents the southwestern limit of the Laurentide Ice Sheet and is considered to be the driest and westernmost area within the vast network of glacially derived prairie pothole landforms of the northern Great Plains. Elevation ranges from 2,000 feet (610 meters) to 4,600 feet (1,400 meters).

Soils are primarily Mollisols, but Entisols, Inceptisols, Alfisols, and Vertisols are also common. Till from continental glaciation is the predominant parent material, but alluvium and bedrock are also common. Till deposits are typically less than 50 feet thick, and in some areas glacially deformed bedrock occurs at or near the soil surface (Soller, 2001). Underlying the till is sedimentary bedrock largely consisting of Cretaceous shale, sandstone, and mudstone (Vuke et al., 2007). It is commonly exposed on hillslopes, particularly along drainageways. Significant alluvial deposits occur along glacial outwash channels and major drainages, including portions of the Missouri, Teton, Marias, Milk, and Frenchman Rivers. Large glacial lakes, particularly in the western half of the MLRA, deposited clayey and silty lacustrine sediments (Fullerton et al., 2013).

Much of the western portion of this MLRA was glaciated towards the end of the Wisconsin age, and the maximum glacial extent occurred approximately 20,000 years ago (Fullerton et al., 2004). The result is a geologically young landscape that is predominantly a level till plain interspersed with lake plains and dominated by soils in the Mollisol and Vertisol orders. These soils are very productive and generally are well suited to dryland farming. Much of this area is aridic-ustic. Crop-fallow dryland wheat farming is the predominant land use. Areas of rangeland typically are on steep hillslopes along drainages.

The rangeland, much of which is native mixedgrass prairie, increases in abundance in the eastern half of the MLRA. The Wisconsin-age till in the north-central part of this area typically formed large disintegration moraines with steep slopes and numerous poorly-drained potholes. A large portion of Wisconsin-age till occurring on the type of the level terrain that would typically be optimal for farming has large amounts of less-suitable sodium-affected Natrustalfs. Significant portions of Blaine, Phillips, and Valley Counties were glaciated approximately 150,000 years ago during the Illinoisan age. Due to erosion and dissection of the landscape, many of these areas have steeper slopes and more exposed bedrock than areas glaciated during the Wisconsin age (Fullerton and Colton, 1986).

While much of the rangeland in the aridic-ustic portion of MLRA 52 is classified as belonging to the “dry grassland” climatic zone, sites in portions of southern MLRA 52 may belong to the “dry shrubland” climatic zone. The dry shrubland zone represents the northernmost extent of the big sagebrush (Artemisia tridentata) steppe on the Great Plains. Because similar soils occur in both southern and northern portions of the MLRA, it is currently hypothesized that climate is the primary driving factor affecting big sagebrush distribution in this area. However the precise factors are not fully understood at this time.

Sizeable tracts of largely unbroken rangeland in the eastern half of the MLRA and adjacent southern Saskatchewan are home to the northern Montana population of greater sage grouse (Centrocercus urophasianus), and large portions of this area are considered to be a Priority Area for Conservation (PAC) by the U.S. Fish and Wildlife Service (U.S. Fish and Wildlife Service, 2013). This population is unique among sage grouse populations because many individuals overwinter in the big sagebrush steppe (dry shrubland) in the southern portion of the MLRA and then migrate to the northern portion of the MLRA, which lacks big sagebrush (dry grassland), to live the rest of the year (Smith, 2013).

Areas of the till plain near the Bearpaw and Highwood Mountains as well as the Sweetgrass Hills and Rocky Mountain foothills are at higher elevations, receive higher amounts of precipitation, and have a typic-ustic moisture regime. These areas have significantly more rangeland production than the drier aridic-ustic portions of the MLRA and have enough moisture to produce crops annually rather than just bi-annually, as in the drier areas. Ecological sites in this higher precipitation area are classified as the moist grassland climatic zone.

Classification relationships

NRCS Soil Geography Hierarchy
• Land Resource Region: Northern Great Plains
• Major Land Resource Area (MLRA): 052 Brown Glaciated Plains
• Climate Zone: N/A

National Hierarchical Framework of Ecological Units (Cleland et al., 1997; McNab et al., 2007)
• Domain: Dry
• Division: Temperate Steppe
• Province: Great Plains-Palouse Dry Steppe Province 331
• Section: Northwestern Glaciated Plains 331D
• Subsection: Montana Glaciated Plains 331Dh
• Landtype association/Landtype phase: N/A

National Vegetation Classification Standard (Federal Geographic Data Committee, 2008)
• Class: Mesomorphic Shrub and Herb Vegetation Class (2)
• Subclass: Shrub and Herb Wetland Subclass (2.C)
• Formation: Temperate to Polar Freshwater Marsh, Wet Meadow, and Shrubland Formation (2.C.4)
• Division: Alnus viridis ssp. sinuata - Salix boothii / Carex spp. Western North American Freshwater Marsh, Wet Meadow, and Shrubland Division (2.C.4.Nb)
• Macrogroup: Arid West Interior Freshwater Marsh Macrogroup (2.C.4.Nb.1)
• Group: Schoenoplectus spp. - Typha spp. Interior Freshwater Marsh Group (2.C.4.Nb.1.a)

USFWS (Cowardin et al., 1979)
• Palustrine Persistent Emergent Semi-Permanently Flooded

Montana Riparian and Wetland Sites (Hansen et. al, 1995)
• Hardstem Bulrush Habitat Type and/or Common Cattail Habitat Type

Ecological site concept

This provisional ecological site occurs in all climatic zones of MLRA 52. Figure 1 illustrates the distribution of the Slough ecological site based on current data. Current mapping does not consistently identify the Slough ecological site when it occurs as a minor component of the mapunit, therefore this map will require future revision. Slough is a limited extent ecological site occurring throughout MLRA 52. Typically, it occurs in backwater areas on floodplains such as oxbows, relic channels, and open depressions. The ponding duration is typically semi-permanent, however, it is highly variable depending on catchment size and annual precipitation. This site is typically non-saline, but may be brackish in some instances.

The distinguishing characteristics of this site are that it is located on floodplains, has a seasonal high water table less than 24 inches from the soil surface, and contains hydric soils. Soils for this ecological site are typically very deep (more than 60 inches) and derived from alluvium. Soil textures in the upper 4 inches are typically loam, silt loam, or silty clay loam. Soils are endosaturated, meaning they receive additional moisture from groundwater.

Characteristic vegetation is broadleaf cattail (Typha latifolia), hardstem bulrush (Schoenoplectus acutus), and spikerush (Eleocharis spp.).

Associated sites

FX052X99X060	**Overflow (Ov)** The Overflow ecological site is adjacent to the Slough ecological site, usually on the highest terraces where flooding is rare or occasional and hydrophytic vegetation is not present.
FX052X99X061	**Riparian Woodland (RW)** The Riparian Woodland ecological site is adjacent to the Slough ecological site, usually on the highest terraces where hydrophytic vegetation is not present. The site is dominated by woody species.
FX052X99X150	**Subirrigated (Sb)** The Subirrigated ecological site is adjacent to the Slough ecological site, usually on higher positions where groundwater is 24 to 40 inches from the surface. The site is dominated by facultative wetland species.

Similar sites

FX052X99X150	**Subirrigated (Sb)** The Subirrigated ecological site differs from the Slough ecological site, in that it occurs on higher landscape positions. Depth to a water table is 24 to 40 inches. Obligate wetland species are rare and the site is dominated by facultative wetland species.
FX052X99X071	**Recharge Closed Depression (Cdr)** The Recharge Closed Depression ecological site differs from the Slough ecological site, in that it receives its moisture primarily from surface runoff rather than groundwater discharge. It is in closed depressions on uplands rather than on floodplains. Hydroperiods are much shorter and deep marsh vegetation is rare or absent.
FX052X99X705	**Discharge Closed Depression (Cdr)** The Discharge Closed Depression ecological site differs from the Slough ecological site, in that it occurs in closed depressions on uplands rather than on floodplains. Hydroperiods are much shorter and deep marsh vegetation is rare or absent.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Legacy ID

R052XY084MT

Physiographic features

Slough is an ecological site of limited extent occurring in depressions and oxbows on flood plains

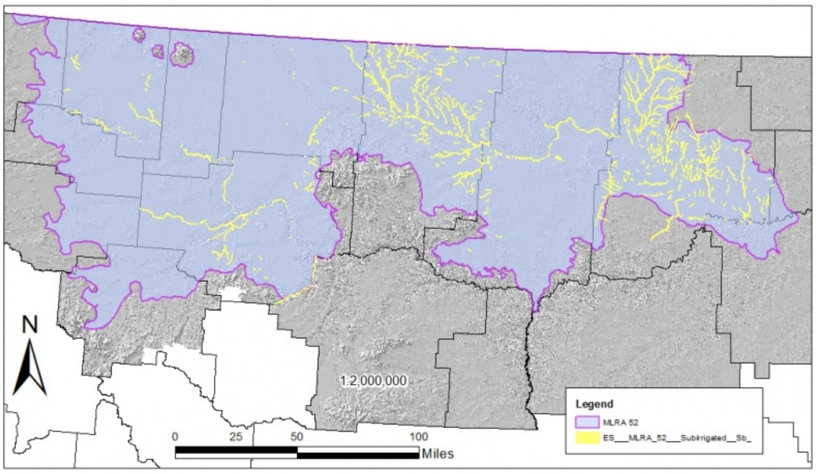

Figure 1. Figure 1. General distribution of the Slough ecological site by mapunit extent

Table 2. Representative physiographic features

Landforms	(1) River valley > Depression (2) River valley > Oxbow (3) River valley > Flood plain
Ponding duration	Brief (2 to 7 days) to long (7 to 30 days)
Ponding frequency	Occasional to frequent
Elevation	610–1,402 m
Slope	0–2%
Ponding depth	0–30 cm
Water table depth	0–61 cm
Aspect	Aspect is not a significant factor

Climatic features

The Brown Glaciated Plains is a semi-arid region with a temperate continental climate that is characterized by frigid winters and warm to hot summers (Cooper et al., 2001). The average frost-free period for this ecological site is 115 days. The majority of precipitation occurs as steady, soaking, frontal system rains in late spring to early summer. Summer rainfall comes mainly from convection thunderstorms that typically deliver scattered amounts of rain in intense bursts. These storms may be accompanied by damaging winds and large-diameter hail and result in flash flooding along low-order streams. Severe drought occurs on average in 2 out of every 10 years. Annual precipitation ranges from 10 to 17 inches, and 70 to 80 percent of this occurs during the growing season (Cooper et al., 2001). Extreme climatic variations, especially droughts, have the greatest influence on species cover and production (Coupland, 1958, 1961; Biondini et al., 1998).

During the winter months, the western half of MLRA 52 commonly experiences chinook winds, which are strong west to southwest surface winds accompanied by abrupt increases in temperature. The chinook winds are strongest on the western boundary of the MLRA near the Rocky Mountain foothills and decrease eastward. In addition to producing damaging winds, prolonged chinook episodes can result in drought or vegetation kills due to the reaction of plants to a “false spring” (Oard, 1993).

Table 3. Representative climatic features

Frost-free period (average)	115 days
Freeze-free period (average)	140 days
Precipitation total (average)	330 mm

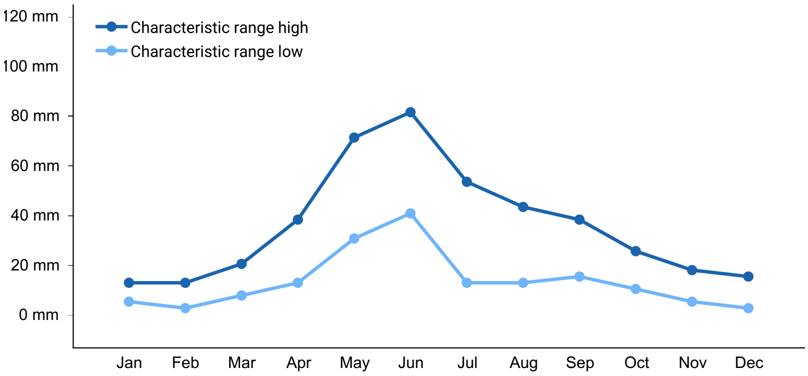

Figure 2. Monthly precipitation range

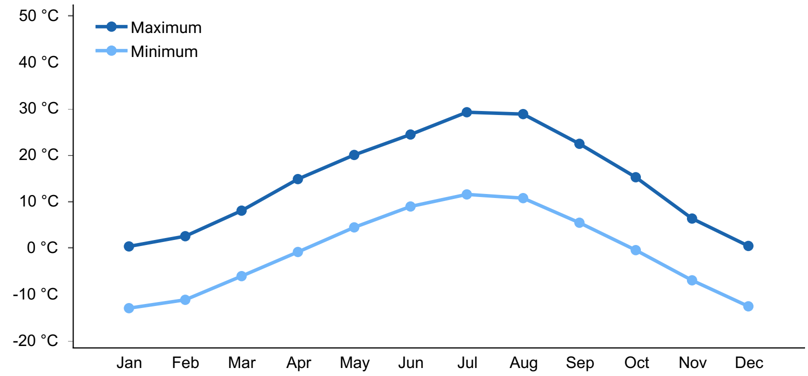

Figure 3. Monthly average minimum and maximum temperature

Climate stations used

- (1) GERALDINE [USC00243445], Geraldine, MT
- (2) CONRAD [USC00241974], Conrad, MT
- (3) TURNER 11N [USC00248415], Turner, MT
- (4) CONTENT 3 SSE [USC00241984], Zortman, MT
- (5) GOLDBUTTE 7 N [USC00243617], Sunburst, MT
- (6) SACO 1 NNW [USC00247265], Saco, MT
- (7) CARTER 14 W [USC00241525], Floweree, MT
- (8) CHESTER [USC00241692], Chester, MT
- (9) HARLEM [USC00243929], Harlem, MT
- (10) LOMA 1 WNW [USC00245153], Loma, MT

Influencing water features

This is a riverine wetland site that receives additional moisture from groundwater and occasionally stream overflow. Hydrology is most similar to a lotic stream hydrogeomorphic (HGM) model (Tiner, 2003). It typically occurs on low gradient or intermittent gradient reaches, although many reaches on larger streams have been dammed. Typically, the site maintains groundwater connectivity with the stream channel for the majority of the year. During spring runoff the sites receives surface overflow from the stream as well as subsurface flow. Groundwater dynamics are not well documented, but it is most likely a flow-through site or discharge site. Typically, the ponding duration is typically 6 months or more and ponding depth is typically 1 foot or more.

Soil features

The Slough concept covers about 25,000 acres in MLRA 52. Soils that best represent the central concept for this ecological site are Bigsandy and Lallie. These soils are in the Fluvaquents great group and are characterized by a surface horizon that lacks enough organic matter to have a mollic epipedon. The Bigsandy soil is in the fine-loamy family, meaning it contains between 18 and < 35 percent clay in the particle-size control section, and has mixed mineralogy. The Lallie soil is in the fine family, meaning it contains between 35 and 60 percent clay in the particle-size control section, and has smectitic mineralogy. The parent material for these soil series is typically alluvium deposits. These and all soils in this concept are endosaturated, meaning that they receive additional moisture from groundwater, and have hydric features. Ponding frequency varies from occasional to frequent and duration is typically long. All soils in this concept have an aquic moisture regime, which means that the soils are saturated within 40 inches (100 cm) of the mineral soil surface for some time during the year. These soils have a frigid soil temperature regime (Soil Survey Staff, 2014).

Soil textures in the surface horizon on this site are typically loam, silt loam, or silty clay loam; and the underlying horizons vary from loam to silty clay. Hydric features such as redox or gleying may be present in any horizon. In the surface 20 inches, electrical conductivity is typically less than 4; and the sodium absorption ratio is less than 13. The surface horizon typically contains 2 to 5 percent organic matter; and moist colors vary from dark grayish brown (10YR 4/2) to black (10YR 2/1). Calcium carbonate equivalent is typically less than 15 percent in the upper 5 inches of soil. Soil pH classes are neutral to strongly alkaline in the surface horizon and slightly alkaline to strongly alkaline in the subsurface horizons. The soil depth class for this is site is typically very deep (more than 60 inches). Typically, the upper 20 inches of soil does not contain coarse fragments.

Table 4. Representative soil features

Parent material	(1) Alluvium
Surface texture	(1) Loam (2) Silt loam (3) Silty clay loam
Drainage class	Poorly drained to very poorly drained
Soil depth	152–183 cm
Available water capacity (0-101.6cm)	12.95–18.54 cm
Calcium carbonate equivalent (0-12.7cm)	0–14%
Electrical conductivity (0-50.8cm)	0–3 mmhos/cm
Sodium adsorption ratio (0-50.8cm)	0–12
Soil reaction (1:1 water) (0-101.6cm)	6.6–9

Ecological dynamics

The information in this ecological site description, including the state-and-transition model (STM) (Figure 2), was developed based on historical data, current field data, professional experience, and a review of the scientific literature. As a result, all possible scenarios or plant species may not be included. Key indicator plant species, disturbances, and ecological processes are described to inform land management decisions.

The Slough provisional ecological site in MLRA 52 Dry Grassland consists of three vegetative states: The Reference State (1.0), the Invaded State (2.0), and the Hydrologically Altered State (3.0). Historically, plant communities associated with the Slough ecological site evolved under the combined influences of climate, grazing, hydrology, and fire. Extreme climatic variability results in frequent droughts, which can have great influence on the relative contribution of species cover and production (Coupland, 1958, 1961; Biondini et al., 1998).

Hydrology is a crucial dynamic on this site. The site receives water primarily from groundwater and generally connected hydrologically with an adjacent stream. During the spring, the site can also be flooded by stream overflow. The duration of ponding, or hydroperiod, dramatically influences the vegetation of the site. Typically the hydroperiod for this site is considered semi-permanent, meaning the site is inundated for 6 to 9 months. Over the short term, the hydroperiod is relatively stable, but climatic variation over the long term creates the hydrological fluctuation necessary for maintaining plant species diversity. Typically, wet-drought climatic cycles occur every 10 to 20 years during which the Slough ecological site transitions between the Shallow Marsh Phase (1.1), the Deep Marsh Phase (1.2), and the Open Water Phase (1.3). Plant communities vary depending on the hydroperiod and many species require drawdown during drought cycles to regenerate and maintain diversity on the site.

Native grazers also shaped these plant communities. Bison (Bison bison) were the dominant historic grazer, but pronghorn (Antilocapra americana), elk (Cervus canadensis), and deer (Odocoileus spp.) were also common. Grasshoppers and periodic outbreaks of Rocky Mountain locusts (Melanoplus spretus) may have also played an important role in the ecology of these communities (Lockwood, 2004).

The historic ecosystem also experienced relatively frequent lightning-caused fires with estimated fire return intervals of 6 to 25 years (Bragg, 1995). Historically, Native Americans also set periodic fires. The majority of lightning-caused fires occurred in July and August, whereas Native Americans typically set fires during spring and fall to correspond with the movement of bison (Higgins, 1986). Generally, fires were less frequent on the Slough ecological site than on adjacent drier sites, however, early reports indicate that fires did occur in wetlands (Higgins, 1986). The Slough ecological site is resilient to fire and the most significant effects of fire are most likely removing excess litter accumulations and triggering resprouting and reseeding of cattail and hardstem bulrush (Esser, 1995; Gucker, 2008). Long-term fire suppression in the 20th century removed periodic fire from the ecosystem altogether. This practice lead to an increase in litter accumulation and decreased regeneration of native species, which in some cases, may provide ideal conditions for seed germination and seedling establishment of invasive species such as Canada thistle.

Plant communities on the Slough ecological site are very complex. Much of the dynamics of this site are still under investigation and are not fully understood. Frequently, sites contain multiple plant community zones that correspond to the depth and duration of ponding for that portion of the site. During drought cycles, the site is typically in the Shallow Marsh Phase (1.1). In this phase, the center of the depression is dominated by a sedge-spikerush plant community with an area of drawdown around the edges. This drawdown area is frequently open mud flats, which provides a medium for cattail and bulrush to reseed. Periods of average precipitation will transition the site to the Deep Marsh Phase (1.2). In this phase the ponding depth increases and the mudflats around the edges are inundated. Cattail and bulrush dominate the site, particularly in the deepest portions. A sedge-spikerush plant community may establish on the fringes where the hydroperiod is shorter and water depth is shallow as well as numerous other wetland species. The Deep Marsh Phase (1.2) supports a diverse community of hydrophytic plants. During cycles of above average precipitation, the site will transition to the Open Water Phase (1.3). Over time cattails and bulrush become decadent and die out. The site becomes open water in the center with a stand of cattail and bulrush around the fringes. Plant communities in all phases are often dynamic and diversity varies from site to site. Further study is needed to fully describe all major species and plant community dynamics.

Major dams, irrigation projects, and water impoundment have had significant effects on the hydrology of this site. Major dams regulate river flows, resulting in more constant flows and less seasonal variation in the water table. Irrigation, particularly flood irrigation, raises water tables and further reduces seasonally variations. Impoundment of water increases inundation periods as well as ponding depths. These hydrological alterations have had significant impacts on the Slough ecological site, especially in the Milk River valley.

The effects of improper grazing are largely unknown on this site. Due to wetness and the lack of palatable forage, livestock use of this site is generally limited. However, livestock may utilize the site if conditions dry out sufficiently (Hansen et al., 1995). Improper grazing practices include any practices that do not allow sufficient opportunity for plants to physiologically recover from a grazing event or multiple grazing events within a given year and/or may not be providing adequate cover to prevent soil erosion over time. This may include, but is not limited to, overstocking, continuous grazing, and/or inadequate seasonal rotation moves over multiple years.

Invasive species are not common on this ecological site, but invasive species have been observed in some instances. Potential invasive species include reed canarygrass (*Phalaris arundinacea*), narrowleaf cattail (*Typha angustifolia*), and European common reed (*Phragmites australis* subsp. australis). Noxious weeds, such as purple loosestrife (*Lythrum salicaria*) and Eurasian watermilfoil (*Myriophyllum spicatum*), are rare but can become a major concern if left unchecked.

The state-and-transition model (STM) diagram (Figure 2) suggests possible pathways that plant communities on this site may follow as a result of a given set of ecological processes and management. The site may also support vegetative states not displayed in the STM diagram. Land owners and land managers should seek guidance from local professionals before prescribing a particular management or treatment scenario. Plant community responses vary across this MLRA due to variability in weather, soils, and aspect. The Reference State (1) may not necessarily be the management goal. The lists of plant species and species composition values are provisional and are not intended to cover the full range of conditions, species, and responses for the site. Species composition by dry weight is provided when available and is considered provisional based on the sources identified in the narratives associated with each community phase.

State and transition model

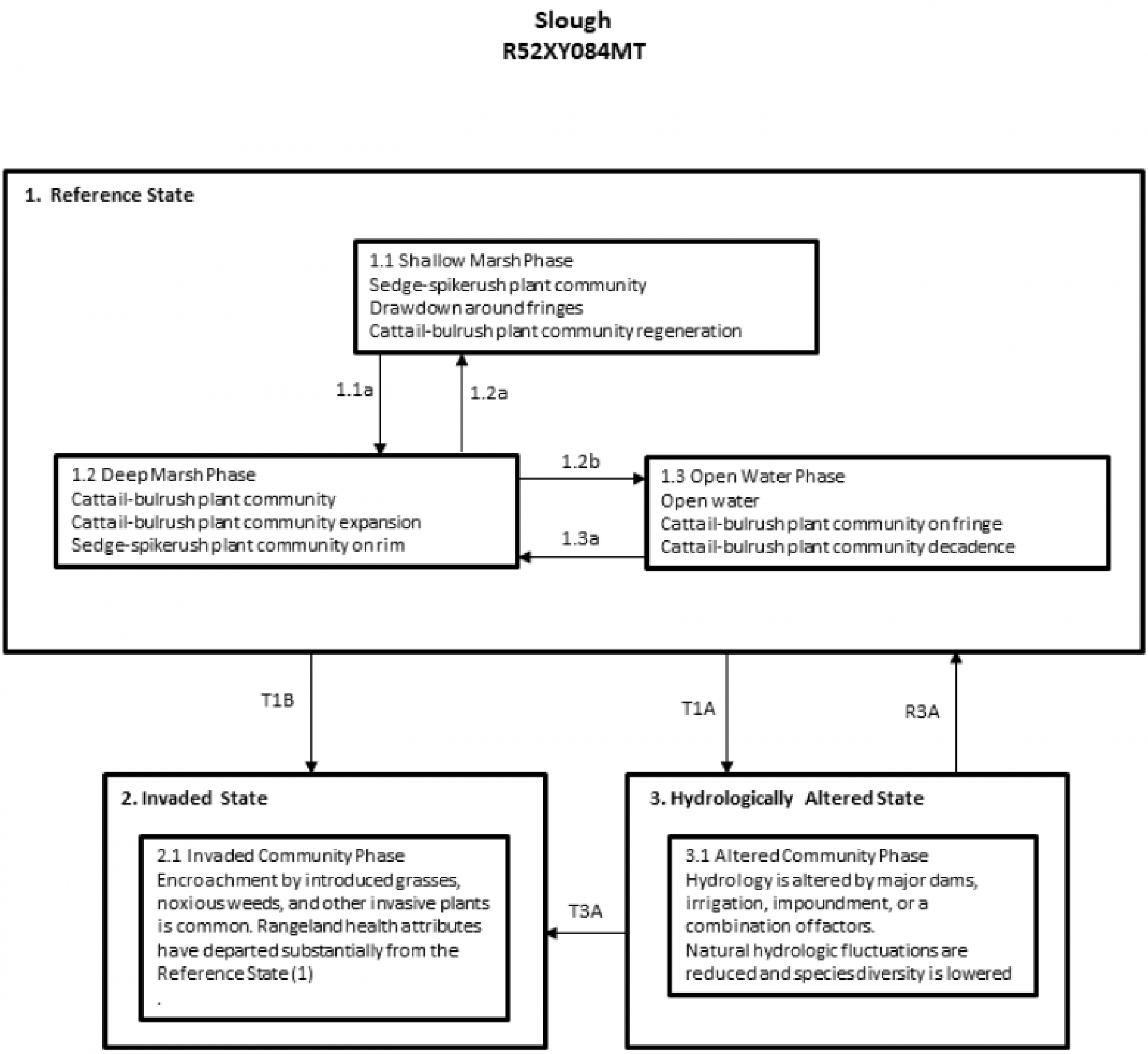

Figure 2. State-and-transition diagram

Slough
R52XY084MT

Legend

- 1.1a 2 or more years of average precipitation
- 1.2a drought
- 1.2b 2 or more years of above average precipitation
- 1.3a 2 or more years of average precipitation
- T1A alteration of hydrology by major dams, irrigation, etc.
- T1B, T3A introduction of invasive species
- R3A restoration of natural hydrology and species diversity (labor intensive and costly)

Figure 2 (continued)

State 1
Reference State

Scientific Name	Common Name	Growth Form	Duration	Nativity
Achillea millefolium	common yarrow	Forb	Perennial	Native
Achnatherum nelsonii	Columbia needlegrass	Graminoid	Perennial	Native
Agoseris glauca	pale agoseris	Forb	Perennial	Native
Agrostis scabra	rough bentgrass	Graminoid	Perennial	Native
Allium geyeri	Geyer's onion	Forb	Perennial	Native
Allium textile	textile onion	Forb	Perennial	Native
Antennaria microphylla	littleleaf pussytoes	Forb	Perennial	Native
Apocynum cannabinum	Indianhemp	Forb	Perennial	Native
Argentina anserina	silverweed cinquefoil	Forb	Perennial	Native
Artemisia cana	silver sagebrush	Shrub	Perennial	Native
Artemisia frigida	prairie sagewort	Shrub	Perennial	Native
Artemisia ludoviciana	white sagebrush	Forb	Perennial	Native
Atriplex argentea	silverscale saltbush	Forb	Annual/Biennial	Native
Beckmannia syzigachne	American sloughgrass	Graminoid	Annual/Biennial	Native
Bouteloua gracilis	blue grama	Graminoid	Perennial	Native
Calamagrostis stricta	northern reedgrass	Graminoid	Perennial	Native
Calamovilfa longifolia	prairie sandreed	Graminoid	Perennial	Native
Carex aquatilis	water sedge	Graminoid	Perennial	Native
Carex buxbaumii	Buxbaum's sedge	Graminoid	Perennial	Native
Carex nebrascensis	Nebraska sedge	Graminoid	Perennial	Native
Carex pellita	woolly sedge	Graminoid	Perennial	Native
Carex praegracilis	clustered field sedge	Graminoid	Perennial	Native
Carex rostrata	beaked sedge	Graminoid	Perennial	Native
Carex spp.	sedge	Graminoid	Perennial	Native
Carex stipata	sawbeak sedge	Graminoid	Perennial	Native
Carex vesicaria	blister sedge	Graminoid	Perennial	Native
Chamaesyce serpyllifolia	thymeleaf sandmat	Forb	Annual/Biennial	Native
Chenopodium pratericola	desert goosefoot	Forb	Annual/Biennial	Native
Cicuta douglasii	western water hemlock	Forb	Perennial	Native
Cicuta maculata	spotted water hemlock	Forb	Perennial	Native
Collomia linearis	tiny trumpet	Forb	Annual/Biennial	Native
Comarum palustre	purple cinquefoil	Forb	Perennial	Native
Conyza canadensis	Canadian horseweed	Forb	Annual/Biennial	Native
Danthonia spp.	oatgrass	Graminoid	Perennial	Native
Deschampsia caespitosa	tufted hairgrass	Graminoid	Perennial	Native
Distichlis spicata	inland saltgrass	Graminoid	Perennial	Native
Downingia laeta	Great Basin calicoflower	Forb	Annual/Biennial	Native
Echinacea angustifolia	blacksamson echinacea	Forb	Perennial	Native
Eleocharis acicularis	needle spikerush	Graminoid	Perennial	Native
Eleocharis palustris	common spikerush	Graminoid	Perennial	Native
Eleocharis rostellata	beaked spikerush	Graminoid	Perennial	Native
Elymus elymoides	squirreltail	Graminoid	Perennial	Native
Elymus trachycaulus	slender wheatgrass	Graminoid	Perennial	Native
Epilobium ciliatum	fringed willowherb	Forb	Perennial	Native

Figure 4. Table 5. List of plant species observed in riverine wetlands (adapted from Jones [2004]; Hansen et al. [1995])

Epilobium pygmaeum	smooth spike-primrose	Forb	Annual/Biennial	Native
Epilobium spp.	willowherb	Forb	Perennial	Native
Equisetum arvense	field horsetail	Forb	Perennial	Native
Erigeron glabellus	streamside fleabane	Forb	Perennial	Native
Erigeron spp.	fleabane	Forb	Perennial	Native
Gaillardia aristata	common gaillardia	Forb	Perennial	Native
Galium boreale	northern bedstraw	Forb	Perennial	Native
Galium triflorum	fragrant bedstraw	Forb	Perennial	Native
Glaux maritima	sea milkwort	Forb	Perennial	Native
Glyceria grandis	American mannagrass	Graminoid	Perennial	Native
Glycyrrhiza lepidota	American licorice	Forb	Perennial	Native
Gnaphalium palustre	western marsh cudweed	Forb	Annual/Biennial	Native
Grindelia squarrosa	curlycup gumweed	Forb	Annual/Biennial	Native
Hackelia deflexa	nodding stickseed	Forb	Annual/Biennial	Native
Helianthella quinquenervis	fivenerve helianthella	Forb	Perennial	Native
Helianthella uniflora	oneflower helianthella	Forb	Perennial	Native
Helianthus annuus	common sunflower	Forb	Annual/Biennial	Native
Helianthus nuttallii	Nuttall's sunflower	Forb	Perennial	Native
Hesperostipa comata	needle and thread	Graminoid	Perennial	Native
Heterotheca villosa	hairy false goldenaster	Forb	Perennial	Native
Hieracium spp.	hawkweed	Forb	Perennial	Native
Hordeum jubatum	foxtail barley	Graminoid	Perennial	Native
Juncus arcticus ssp. littoralis	Baltic rush	Graminoid	Perennial	Native
Juncus spp.	rush	Graminoid	Perennial	Native
Koeleria macrantha	prairie Junegrass	Graminoid	Perennial	Native
Lemna minor	common duckweed	Forb	Perennial	Native
Lepidium densiflorum	common pepperweed	Forb	Annual/Biennial	Native
Lesquerella arenosa	Great Plains bladderpod	Forb	Annual/Biennial	Native
Linum lewisii	prairie flax	Forb	Perennial	Native
Lomatium spp.	desertparsley	Forb	Perennial	Native
Lycopus asper	rough bugleweed	Forb	Perennial	Native
Maianthemum stellatum	starry false lily of the valley	Forb	Perennial	Native
Mentha arvensis	wild mint	Forb	Perennial	Native
Muhlenbergia asperifolia	scratchgrass	Graminoid	Perennial	Native
Muhlenbergia richardsonis	mat muhly	Graminoid	Perennial	Native
Muhlenbergia spp.	muhly	Graminoid	Perennial	Native
Najas flexilis	nodding waternymph	Forb	Annual	Native
Nassella viridula	green needlegrass	Graminoid	Perennial	Native
Navarretia intertexta	needleleaf navarretia	Forb	Annual/Biennial	Native
Nuphar lutea	yellow pond-lily	Forb	Perennial	Native
Opuntia polyacantha	plains pricklypear	Shrub	Perennial	Native
Pascopyrum smithii	western wheatgrass	Graminoid	Perennial	Native
Pediomelum argophyllum	silverleaf Indian bread- root	Forb	Perennial	Native
Plantago elongata	prairie plantain	Forb	Annual/Biennial	Native
Poa arida	plains bluegrass	Graminoid	Perennial	Native
Poa palustris	fowl bluegrass	Graminoid	Perennial	Native
Poa secunda	Sandberg bluegrass	Graminoid	Perennial	Native
Poa spp.	bluegrass	Graminoid	Perennial	Native

Polygonum amphibium	water knotweed	Forb	Perennial	Native
Polygonum erectum	erect knotweed	Forb	Annual/Biennial	Native
Polygonum ramosissimum	bushy knotweed	Forb	Annual/Biennial	Native
Polygonum spp.	knotweed	Forb	Perennial	Native
Potamogeton natans	floating pondweed	Forb	Perennial	Native
Potentilla gracilis	slender cinquefoil	Forb	Perennial	Native
Puccinellia nuttalliana	Nuttall's alkaligrass	Graminoid	Perennial	Native
Ranunculus cymbalaria	alkali buttercup	Forb	Perennial	Native
Ranunculus spp.	buttercup	Forb	Annual/Biennial	Native
Ratibida columnifera	prairie coneflower	Forb	Perennial	Native
Rhus trilobata	skunkbush sumac	Shrub	Perennial	Native
Ribes aureum	golden currant	Shrub	Perennial	Native
Rosa woodsii	Woods' rose	Shrub	Perennial	Native
Rumex aquaticus	western dock	Forb	Perennial	Native
Rumex salicifolius	willow dock	Forb	Perennial	Native
Sagittaria latifolia	broadleaf arrowhead	Forb	Perennial	Native
Salix amygdaloides	peachleaf willow	Tree	Perennial	Native
Salix exigua	narrowleaf willow	Shrub	Perennial	Native
Salix spp.	willow	Shrub	Perennial	Native
Schoenoplectus acutus	hardstem bulrush	Graminoid	Perennial	Native
Schoenoplectus maritimus	cosmopolitan bulrush	Graminoid	Perennial	Native
Schoenoplectus pungens	common threesquare	Graminoid	Perennial	Native
Schoenoplectus tabernaemontani	softstem bulrush	Graminoid	Perennial	Native
Selaginella densa	lesser spikemoss	Forb	Perennial	Native
Solidago spp.	goldenrod	Forb	Perennial	Native
Spartina gracilis	alkali cordgrass	Graminoid	Perennial	Native
Spartina pectinata	prairie cordgrass	Graminoid	Perennial	Native
Stellaria spp.	starwort	Forb	Annual/Biennial	Native
Stuckenia filiformis	fineleaf pondweed	Forb	Perennial	Native
Suaeda calceoliformis	Pursh seepweed	Forb	Annual/Biennial	Native
Symphoricarpos occidentalis	western snowberry	Shrub	Perennial	Native
Symphyotrichum falcatum	white prairie aster	Forb	Perennial	Native
Symphyotrichum spathulatum	western mountain aster	Forb	Perennial	Native
Thermopsis rhombifolia	prairie thermopsis	Forb	Perennial	Native
Triglochin maritimum	seaside arrowgrass	Graminoid	Perennial	Native
Typha latifolia	broadleaf cattail	Forb	Perennial	Native
Urtica dioica	stinging nettle	Forb	Perennial	Native
Veronica peregrina	neckweed	Forb	Annual/Biennial	Native
Vicia americana	American vetch	Forb	Perennial	Native
Viola spp.	violet	Forb	Perennial	Native
Xanthium strumarium	rough cocklebur	Forb	Annual/Biennial	Native
Zigadenus elegans	mountain deathcamas	Forb	Perennial	Native

The Reference State (1) contains three community phases. Ecological dynamics of this state are still under investigation, therefore, this model may not cover the full range of conditions, species, and responses for the state. Seasonal ponding is a key dynamic on this site and varies depending on annual precipitation patterns and groundwater inputs. Vegetation is typically characterized by zones within the site that correspond to the hydroperiod of that particular zone. Phases usually exhibit two or more zones with the most hydrophytic vegetation in the center of the site and subsequent, drier plant communities toward the edges. Dominant plant species that occur on the Slough ecological site are cattail, bulrush, sedges, and spikerush (Jones, 2004; Hansen et al., 1995). Plant communities can be diverse and may contain numerous other species in addition to the dominant species. Table 5 contains a list of species that have been observed in the Reference State (1). Cyclical periods of drought and wet occur, on average, every 10 to 20 years and are a crucial ecological process on this site (Luna et. al., 2010). During these cycles the site undergoes a dry phase that promotes regeneration of key species such as hardstem bulrush and broadleaf cattail, which require open mudflats to regenerate. This cyclical pattern helps to maintain stand integrity, species diversity, and wildlife habitat. Community Phase 1.1: Shallow Marsh Phase The Shallow Marsh Phase (1.1) occurs during drought cycles. Ponding depth and hydroperiod are reduced and the center of the site supports a sedge-spikerush dominated plant community. The fringes of the site drawdown to bare mudflats in this stage, providing ideal conditions for germination and regeneration of cattails and bulrushes. Community Phase Pathway 1.1a Two or more years of average precipitation will transition the Shallow Marsh Phase (1.1) to the Deep Marsh Phase (1.2). Community Phase 1.2: Deep Marsh Phase The Deep Marsh Phase (1.2) occurs during periods of average or near average precipitation. In this phase the hydroperiod ranges from 6 to 9 months. Vegetation exhibits zonation in this phase. At the center of the depression, where ponding depth is greatest, a cattail-bulrush plant community appears. The most common species in this zone are broadleaf cattail, hardstem bulrush, and common threesquare. A sedge-spikerush plant community is usually present around the rim of the site and frequently supports water sedge, Nebraska sedge, and needle spikerush. A number of minor graminoid species such as American sloughgrass, prairie cordgrass, and rushes may also be present. Stands of cattail and bulrush are expanding in this phase. Species diversity is very high in this phase. Community Phase Pathway 1.2a Drought will transition the Deep Marsh Phase (1.2) to the Shallow Marsh Phase (1.1). Community Phase Pathway 1.2b Two or more years of above-average precipitation will transition the Deep Marsh Phase (1.2) to the Open Water Phase (1.3). Community Phase 1.3: Open Water Phase The Open Water Phase (1.3) occurs during wet climatic cycles. It is characterized by a long hydroperiod (8 to 9 months) and the development of an open water area in the center of the site. Cattail and bulrush stands are declining and limited to the fringes of the site. Aquatic species such as water knotweed, pondweed, and duckweed are common. A number of minor species such as sedges, rushes, and grasses may also be present. Species diversity in this phase will decline over time until water levels are drawn down by the natural climate cycle. Community Phase Pathway 1.3a Two or more years of average precipitation will transition the Open Water Phase (1.3) to the Deep Marsh Phase (1.2). Transition T1A Hydrologic alteration due to dams, irrigation, impoundment, or a combination of factors will transition the Reference State (1) to the Hydrologically Altered State (3). Transition T1B Introduction of invasive species will transition the Reference State (1) to the Invaded State (2).

State 2
Invaded State

The Invaded State (2) occurs when invasive plant species invade adjacent native plant communities. Invasive species are not common, nor are they well documented on the Slough ecological site. However, species such as reed canarygrass, narrowleaf cattail, and European common reed have been observed on this site in some instances. Left unchecked, these species can form dense stands and reduce cover and diversity of desirable species. Noxious weeds are also rare on the Slough ecological site, however, weeds such as purple loosestrife and Eurasian watermilfoil have been documented in MLRA 52 and would become a major concern if established on this site. These species are very aggressive perennials that typically displace native species and dominate ecological function when they invade a site. Sometimes, these species can be suppressed through intensive management (herbicide, biological control, or intensive grazing management). Control efforts are unlikely to eliminate noxious weeds, but their density can be sufficiently suppressed so that species composition and structural complexity are similar to that of the Reference State (1). However, cessation of control methods will most likely result in recolonization of the site by the noxious species. Community Phase 2.1: Invaded Community Phase The Invaded Community Phase (2.1) occurs when encroachment by introduced grasses, noxious weeds, and other invasive plants are common. Rangeland health attributes have departed substantially from the Reference State (1).

State 3
Hydrologically Altered State

The Hydrologically Altered State (3) occurs when hydrology is altered by damming, irrigation projects, or water impoundment. Natural drought/wet cycles are reduced or eliminated and the associated variations in hydroperiod are diminished. The result is a perpetual Open Water Phase (1.3) and a reduction in biodiversity and emergent vegetation regeneration. This state is particularly common in the Milk River valley where large storage reservoirs have regulated stream flows and flood irrigation has raised water tables across much of the floodplain. Community Phase 3.1: Altered Community Phase The Altered Community Phase (3.1) consists of a predominantly open water wetland with a fringe area dominated by emergent perennials such as broadleaf cattail, hardstem bulrush, and common threesquare. Stands of emergent vegetation are frequently monocultures with very little regeneration. Natural drawdown cycles necessary for regeneration are drastically reduced. A shallow marsh zone supporting sedge and spikerush species may be present, but is generally very narrow. Species richness and diversity are much less than in the Reference State (1). Restoration Pathway R3A Restoration of natural hydrology and species diversity transitions the Altered State (3) to the Reference State (1). Restoration of natural hydrology may require removal of dams or diversions, and alteration of irrigation practices. Depending on site conditions, revegetation may be required to restore species diversity. Specialized seeding techniques may be necessary as well as intensive weed control to prevent invasion of exotic species and noxious weeds. These restoration methods are labor intensive, very costly, and may be impractical, perhaps even detrimental, in most situations. Transition T3A Introduction of invasive species will transition the Hydrologically Altered State (3) to the Invaded State (2).

Inventory data references

No field plots were available for this site. A review of the scientific literature and professional experience was used to approximate the plant communities for this provisional ecological site. Information for the state-and-transition model was obtained from the same sources. All community phases are considered provisional based on current knowledge and the sources identified in this ecological site description.

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Contributors

Scott Brady
Stuart Veith

Approval

Scott Brady, 7/01/2019

Acknowledgments

This provisional ecological site description could not have been completed without the contributions of Karen Newlon. She conducted an extensive literature review, which provided most of the background information for this project as well as many of the references. She also co-authored the Loamy and Thin Claypan Dry Grassland ecological sites previously prepared in MLRA 52.

A number of USDA-NRCS and USDI-BLM staff supported this project. Staff contributions are as follows:

Soil Concepts, Soils Information, and Field Descriptions
Charlie French, USDA-NRCS
Josh Sorlie, USDI-BLM

NASIS Reports, Data Dumps, and Soil Sorts
Bill Drummond, USDA-NRCS
Pete Weikle, USDA-NRCS

Peer Review and Beta Testing
Kirt Walstad, USDA-NRCS
Kyle Steele, formerly USDA-NRCS
Kelsey Molloy, USDA-NRCS
Rick Caquelin, USDA-NRCS
Josh Sorlie, USDI-BLM
BJ Rhodes, USDI-BLM

Editing
Ann Kinney, USDA-NRCS
Jenny Sutherland, USDA-NRCS

Quality Control
Jon Siddoway, USDA-NRCS

Quality Assurance
Stacey Clark, USDA-NRCS

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

---

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

---

14. **Average percent litter cover (%) and depth (in):**

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

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17. **Perennial plant reproductive capability:**
